

**Citation:**

Kusumaningrum HD, van Asselt ED, Beumer RR, Zwietering MH. A quantitative analysis of cross-contamination of *Salmonella* and *Campylobacter* spp. via domestic kitchen surfaces. *J Food Prot.* 2004 Sep; 67 (9): 1,892-1,903.

**PubMed ID:** [15453579](#)

**Study Design:**

Systematic review, Quantitative risk analyses

**Class:**

M - [Click here](#) for explanation of classification scheme.

**Research Design and Implementation Rating:**

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

**Research Purpose:**

To estimate the probability and level of contamination of *Salmonella* and *Campylobacter* spp. on salads as the result of cross-contamination from contaminated chicken carcasses via kitchen surfaces. The probability of illness incurred by consuming the contaminated foods was also predicted.

**Inclusion Criteria:**

None specifically mentioned.

**Exclusion Criteria:**

None specifically mentioned.

**Description of Study Protocol:****Recruitment**

- Data on the prevalence and numbers of bacteria on retail chicken carcasses, the use of unwashed surfaces to prepare foods and vegetable consumption were collected from scientific literature
- The rates of bacterial transfer were collected from laboratory experiments and literature.

**Design**

Systematic review/Quantitative analysis.

**Dietary Intake/Dietary Assessment Methodology**

Not applicable.

### **Blinding Used**

Not applicable.

### **Intervention**

Not applicable.

### **Statistical Analysis**

- Using probability density functions, both the variability and the uncertainty of the variables were incorporated into the results
- A deterministic approach and Monte Carlo simulations that incorporated input parameter distributions were used to estimate the contamination of the product
- Both bacterial counts and percentages of transfer rates were log transformed to obtain normally distributed errors
- Statistical analysis was performed using univariate ANOVA
- Probability of illness per serving of contaminated salad was estimated with two dose-response models.

### **Data Collection Summary:**

- *Timing of measurements*: Not applicable
- *Dependent variables*:
  - Rates of bacterial transfer: 5ml of bacterial cell suspension spread evenly on 150g portion of raw chicken breast meat and held at room temperature for 15 minutes
  - Additional experiments involved cucumbers and lettuce
- *Independent variables*: Prevalence and numbers of bacteria on retail chicken carcasses, the use of unwashed surfaces to prepare foods and vegetable consumption
- *Control variables*: Not applicable.

### **Description of Actual Data Sample:**

- *Initial N*:
  - Six studies on *Salmonella*, seven studies on *Campylobacter* (published in 1999 to 2002 for recency)
  - Five studies on the prevalence of using unwashed surfaces during the preparation of raw and cooked or ready-to-eat foods
- *Attrition (final N)*: As above
- *Age*: Not applicable
- *Ethnicity*: Not applicable
- *Other relevant demographics*: None listed
- *Anthropometrics*: None listed
- *Location*: International studies.

### **Summary of Results:**

#### **Key Findings**

- Results have shown that the probability of *Campylobacter* spp. contamination on salads was higher than that of *Salmonella* spp., since both the prevalence and levels of *Campylobacter* spp. on chicken carcasses are higher than those of *Salmonella* spp
- The presence of *Salmonella* and *Campylobacter* spp. was qualitatively found in 4% to 53% and 26% to 83% of retail chicken carcasses, respectively
- On average, 26% of the consumers did not wash the surfaces during the preparation of raw and cooked or ready-to-eat foods
- However, the same studies also indicated that only approximately 60% of the consumers always washed the surfaces during their preparation of raw and ready-to-eat foods
- The mean value of the probability of contamination with *Salmonella* spp. was 4% with a 90% confidence interval of 0.3 to 10%
- Contamination with *Campylobacter* spp. was estimated to occur at a higher percentage than contamination with *Salmonella* spp., with a mean value of 13% and a 90% CI of 1 to 27%
- Based on Monte Carlo simulation, the mean value of the prevalence of salad contamination (Pv) with *Salmonella* spp. is 4%, and the mean value with *Campylobacter* is 13%
- Using the Beta-Poisson model and the actual data, the proportion of illness caused by *Salmonella* and *Campylobacter* spp. is one of 300,000 people and one of 13 people, respectively
- Three distinct ways of reducing the probability of illness were analyzed:
  - Reducing the prevalence of *Campylobacter*-positive retail chicken carcasses
  - Reducing the concentration of *Campylobacter* spp. on the contaminated chickens
  - Improving the use of washed surfaces, clean surfaces or both during food handling.

#### Author Conclusion:

- This study illustrates how cross-contamination during food preparation in domestic kitchens can be modeled by linking currently available data with experimental data and shows that it is realistic to expect that a fraction of the human exposure to *Campylobacter* spp., in particular, originates from cross-contamination in private kitchens during food handling
- The number of human campylobacteriosis cases could be reduced either by reducing the degree of *Campylobacter* spp. contamination on chicken carcasses or by improving the hygiene in private kitchens. Since consumers do not know the degree of contamination on the chicken carcasses that enter their homes, it is obviously important to use separate surfaces or to wash the surfaces during the preparation of raw and cooked or ready-to-eat foods
- The model needs to be validated for strains and products other than those used in this study. The quantitative exposure assessment procedure is not static, since the data, assumptions and models used may be changed when new information becomes available. Furthermore, the models can be used in a more extensive microbiological risk assessment to assess the influence of cross-contamination on foodborne disease.

#### Reviewer Comments:

- *Article inclusion and exclusion criteria, search terms and databases not described*
- *Relatively small numbers of studies included*
- *Study validity and quality not assessed*
- *Authors note that the studies were based on the analysis of samples at retail points, neglecting transportation to the home and storage at the home, possibly leading to an underestimation of the levels of bacteria.*

## Research Design and Implementation Criteria Checklist: Review Articles

### Relevance Questions

- |    |   |     |
|----|---|-----|
| 1. | Will the answer if true, have a direct bearing on the health of patients?                       | Yes |
| 2. | Is the outcome or topic something that patients/clients/population groups would care about?     | Yes |
| 3. | Is the problem addressed in the review one that is relevant to nutrition or dietetics practice? | Yes |
| 4. | Will the information, if true, require a change in practice?                                    | Yes |

### Validity Questions

- |     |  |     |
|-----|--|-----|
| 1.  | Was the question for the review clearly focused and appropriate?   | Yes |
| 2.  | Was the search strategy used to locate relevant studies comprehensive? Were the databases searched and the search terms used described?  | No  |
| 3.  | Were explicit methods used to select studies to include in the review? Were inclusion/exclusion criteria specified and appropriate? Were selection methods unbiased?   | No  |
| 4.  | Was there an appraisal of the quality and validity of studies included in the review? Were appraisal methods specified, appropriate, and reproducible?   | No  |
| 5.  | Were specific treatments/interventions/exposures described? Were treatments similar enough to be combined?   | Yes |
| 6.  | Was the outcome of interest clearly indicated? Were other potential harms and benefits considered?   | Yes |
| 7.  | Were processes for data abstraction, synthesis, and analysis described? Were they applied consistently across studies and groups? Was there appropriate use of qualitative and/or quantitative synthesis? Was variation in findings among studies analyzed? Were heterogeneity issues considered? If data from studies were aggregated for meta-analysis, was the procedure described? | Yes |
| 8.  | Are the results clearly presented in narrative and/or quantitative terms? If summary statistics are used, are levels of significance and/or confidence intervals included?   | Yes |
| 9.  | Are conclusions supported by results with biases and limitations taken into consideration? Are limitations of the review identified and discussed?   | Yes |
| 10. | Was bias due to the review's funding or sponsorship unlikely?  | Yes |